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SUMMARY

Costs of Processing and Delivering Fluid Milk in Utah and Montana

Cost of Processing and delivering fluid milk and other products handled by small and medium-sized dairy plants located in outlying communities and urban areas was obtained from 33 fluid milk processing plants in Utah and 9 in Montana covering operations in 1950.

1. Average operating costs of plants in Utah and Montana (processing, delivery, administration) were 5.06 cents per quart of milk equivalent[1]. Thus, when milk is selling for 20 cents per quart, about 15 cents is left for cost of raw milk and containers, and for profits.

2. Cost of processing was 2.37 cents per quart of milk equivalent, accounting for 47 percent of all marketing costs. Delivery costs were 2.12 cents or 42 percent of the total, while administrative costs were 0.57 of a cent or 11 percent of total operating costs.

3. Labor was the most important cost item accounting for 59 percent of operating costs. Truck costs, including depreciation, were next, amounting to 13 percent. Depreciation on buildings and equipment was 4 percent of all costs.

4. There was considerable variation in processing efficiency among the plants in Utah. One small plant had processing costs of 2.1 cents per quart of milk equivalent and another 2.4 cents. Six of the smallest plants had costs between 2.4 and 5 cents, and 3 had costs above 5 cents per quart of milk equivalent. Among the 9 largest plants, 7 had costs less than the average of 2.4 cents, and 1 plant had a cost of 2.6 cents, and another of 3.0. Five of the middle-sized plants had costs under 2.4 cents, 7 had costs between 2.4 and 5.0 cents, and 1 plant's costs were above 5 cents.

5. The 9 largest, 12 medium-sized, and 11 smallest plants were subdivided according to unit cost of processing a quart of milk equivalent. These unit processing costs were closely related to quantity of products processed and capital and labor costs within each of the three groups of plants as follows:

[1] The term *milk equivalent* will be used throughout this text. This measure is equivalent to the handling cost of one quart of milk so the reader can substitute quarts of milk for milk equivalents, but is advised to see the appendix for a more complete explanation of the technical meaning of milk equivalent and how the various products were converted to this common denominator.

(a) As unit processing costs within each of the three groups of plants increased, quantity of products handled per plant declined.

(b) Among the smaller and medium-sized plants, value of capital per milk equivalent used in processing increased as unit processing costs increased and declined among the 9 largest plants as processing costs increased.

(c) Average time required to process each quart of milk equivalent approximately double among each of the 3 groups of plants as unit processing costs increased.

(d) Average labor cost per quart of milk equivalent approximately doubled among the 3 groups of plants as unit processing costs increased.

6. These unit differences in cost constitute a large potential source of savings to fluid milk processing plants. For example, a small plant, processing 200,000 milk equivalents per year at the average cost for these small plants of 4.0 cents, could save $2,000 annually, if its costs could be reduced by 1.0 cent per quart.

7. On the average the 9 largest plants in the study processed milk for 2 cents per quart less than the 11 smallest. This difference in processing costs amounts to a savings of $2,000 for each 100,000 quarts of milk processed and might partially explain why there is a tendency for absorption or liquidation of small milk processing plants in operation.

8. According to these data small plants are as likely to have low per unit delivery costs as large plants. Among these 33 plants there was no particular relationship between delivery costs per quart of milk equivalent and volume of products delivered per plant to indicate association between high or low unit costs and volume. Delivery costs, however, varied considerably among plants, ranging from 0.8 to 4.5 cents per quart of milk equivalent.

Prices of Fluid Milk

A comparison of prices charged for fluid milk in different communities of Utah was made for the three months of November 1951 through January 1952.

1. Prices ranged between 16 and 23 cents. The 16 cent milk was creamline home-delivered, and supplied by a small local dairy. The

23 cent milk was homogenized, cartoned, and sold in a grocery store supplied by one of the 4 largest dairy plants in the state located 250 miles away. Within the same community price differentials of up to 5 cents were found.

2. Most typical price of milk in the northern, more urban areas of the state (areas I and II) was 21 cents for home deliveries and 20 cents for milk in the store.[2] Little variation was found in price of milk sold in these areas.

3. In the outlying communities of the southern part of the state (area III) homogenized, cartoned milk shipped from the 4 largest dairies located in Salt Lake City or Ogden was typically sold in grocery stores for 21 cents, but was priced as high as 23 cents.[3]

4. Milk from local plants in this more rural area was delivered to the doorstep for prices ranging between 16 and 21 cents. A price of 20 cents was most typical.

5. The cartoned milk, supplied by the 4 largest dairies, was apparently offering keen competition to small, local dairies in all parts of the state. This appeared to be true even when the locally supplied creamline milk in bottles was delivered to the door for as much as 5 cents less than the cartoned, homogenized milk sold in grocery stores from the 4 largest dairies.

Quality of Fluid Milk

One-quart samples of fluid milk were obtained from 41 communities in Utah during the 3 month period of November and December 1951 and January 1952. Each sample was scored on the basis of the American Dairy Science Association recommended score card for fluid milk. This includes tests for bacteria count, flavor, sediment, temperature, and container and closure. Summary of this analysis is as follows:

1. The quality of milk samples obtained from the 4 larger dairies was approximately the same in all areas of the state and averaged somewhat higher than samples obtained from the smaller dairies. Milk from these latter dairies was also of approximately the same quality between areas. All but a few small isolated communities have access to milk from both sources, hence, there was little difference in quality of milk available to consumers in urban and rural areas of Utah.

[2] See fig. 1.

[3] See fig. 2.

2. Samples taken from small, local dairies were much more variable in quality ranging from a low score of 55.3 to a high of 95.6. Samples taken from the 4 largest dairies varied between 85.5 and 94.7.

3. There was no evidence of a change in quality when milk had been bottled for as long as two days. A few samples were obtained which, according to store managers, had been on the cold shelf for as long as 6 days with no apparent deterioration in quality.

4. Flavor is probably the most important characteristic of milk influencing volume of sales. Oxidized flavor was the most common flavor criticism, occurring in 24 instances representing 18 percent of the samples. Cooked flavor occurred in 11 or 8 percent of the samples.

CONCLUSIONS

CONSUMERS IN BOTH the outlying communities studied and in urban areas have an adequate supply of wholesome milk available from either or both of two sources: (1) the large dairies which ship milk long distances and (2) smaller local dairy plants.

Unit costs of processing milk are on the average much higher for small dairies than the larger dairies included in this study. These higher costs are one possible reason why many small dairies are going out of business and losing the market to larger plants. Other reasons for the decline in number of small fluid processing plants are an insufficient variety of products and inability to maintain a uniformly high quality.

This reduction in number of small local processing plants is a trade disadvantage since consumers will no longer have available two sources of milk and the resultant advantages of lower price, better quality, and service which probably occur through competition. Also a source of milk not as subject to being cut off during war and other catastrophes will be lost.

Increased processing efficiency, a greater variety of products, and improved quality can be obtained in at least two ways by managers of small, local plants, (1) through internal operating improvements, which enable plants to utilize labor and equipment more efficiently, and (2) by enlarging volume to utilize more fully existing facilities and obtain advantage of labor specialization.

One internal operating improvement which many managers of small medium sized plants might try is to process on an every other day basis instead of daily as is currently the practice with all but one or two plants included in this study. This change should be especially

helpful in reducing labor costs because the processing equipment would need to be assembled and cleaned only 3 times per week instead of 6 times as at present. This practice should be especially helpful to plants where the same small labor force performs all functions pertaining to their business, including gathering, processing, and distributing milk, keeping records, making collections, and in some cases caring for a herd of dairy cows.

Further study is needed to investigate the possible reduction in unit costs which might occur through adoption of this and other practices by plant managers.

Enlarging plant scale of operations should be especially helpful in not only reducing unit processing costs through increased labor and capital efficiency but also enabling plant managers to provide their customers with a larger variety of products, especially cartoned milk, and also to improve their control over quality. This is because the initial and rental costs of cartoning machines are high, making unit costs high unless volume is larger than that obtained by most small and medium sized plants. Larger volumes should increase likelihood of better control over quality from increased labor specialization, thus making it possible for the plant personnel to have fewer individual responsibilities and be more competent in the discharge of each one.

Listed below are two ways, in addition to more aggressive sales promotion, by which small plants could enlarge volume of sales:

1. Two or more small plants in neighboring communities could merge, one owner-operator being responsible for processing and the other for delivery.

2. A small operator in one community could purchase his supply of milk and other dairy products already processed and packaged from a neighboring small plant or from one of the large plants which ship milk long distances.

Data from this study indicate that small and large plants have similar per unit delivery costs but that large plants are generally more efficient in processing than small firms. It is, therefore, recommended that small, local plants that have high processing costs, concentrate on enlarging volume of processing or discontinue it altogether and distribute milk on a full-time basis. It appears unlikely that some small, high-cost plants will be able to compete effectively with larger plants in processing milk, but the evidence gathered does indicate that small firms may be able to compete in the distribution of milk.

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COSTS, QUALITY, AND PRICES OF FLUID MILK IN RURAL AND URBAN AREAS OF UTAH AND MONTANA

By Wells M. Allred and Edward H. Ward[4]

INTRODUCTION

The major purpose of this study was to make an analysis of marketing fluid milk in sparsely populated areas of the West. Costs of processing and delivering milk in small and medium sized processing plants were ascertained. In addition prices and quality of milk available to consumers in sparsely populated and urban areas were compared.

The West, characterized by Utah and Montana, is sparsely populated. Montana, the third largest state in area, has no cities of more than 40,000 population and has a density of 4.1 persons per square mile. Utah, outside of Salt Lake, Ogden, Provo urban areas, has a population density comparable to Montana. The eight mountain states have an average of 5.9 persons per square mile and the eleven western states of 16.6 compared with a density of 50.7 persons for the United States.

Scattered about over these states are many villages and small cities with populations ranging up to 10,000. These include agricultural trading centers, mining or lumbering towns, and service centers for tourists. Many of these population centers are separated by wide areas of land unsuited to dairy production but are sometimes surrounded by a small area of irrigated land. The major land area is used largely for grazing range livestock or for dry land crops. These population centers are often distant from important centers of dairy production and the amount of milk needed is relatively small. Milk is bulky and highly perishable so problems of supplying these areas with a stable and dependable supply of high quality milk have arisen.

Prior to the end of World War II, these cities were generally supplied with milk by a few local farmers. In many cases, however, the supply was not satisfactory either in amount, dependability throughout the season, or in quality. As a result, groups of consumers in some areas made requests of large milk distributors located in distant areas to provide a milk supply. Thus in recent years large dairies in urban areas have been supplying many of these sparsely populated areas with a supplemental milk supply.

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In Utah, there are 4 large fluid milk plants, located in urban centers, which market milk in these areas and ship milk to most of the outlying communities, some of which are located up to 500 miles distance from the processing plant. Fluid milk plants process and sell bottled or cartoned fresh milk, which is their principle product in terms of volume of sales, sweet and sour cream for table use, chocolate drink, buttermilk, skim milk, cottage cheese, yogurt, orange drink, ice cream, butter, and other similar dairy and confectionary products. In addition to these large plants in the urban centers there are a number of smaller dairies which rely on doorstep delivery and some wholesale trade for their business.

Many of the rural communities of the state have a small local dairy plant which supplies part of the fluid milk used by the community and consumers in surrounding areas. It is most typical for the dairy in the rural community to handle most of the doorstep milk business and for the large dairies located in urban centers to handle the wholesale business in the community by supplying grocery stores and cafes with their milk requirements. In some cases, the rural dairy plant distributes milk and other dairy products from one or more of the larger dairies in addition to selling its own processed products.

The situation in Montana is similar. The larger dairies are located in more populous places and supply a large part of the milk requirements to these urban communities and ship fluid milk to the sparsely settled areas. In addition, there are many small plants in rural and urban communities which rely on doorstep delivery for most of their business.

Large plants and most of the small and medium-sized ones obtain their milk from farmer-producers. A few of the smaller plants in both states produce all or part of the milk they process and distribute. Producers serving small and medium-sized plants are usually located within a few miles of the plant while the central plants obtain raw milk from producers located up to several hundred miles distance. Thus, the same milk often covers the same route twice: once, coming to the plant in the raw state from farmers located in outlying communities, and, next, sent back to these communities in cartons as a creamline or homogenized product.

The competitive pressure is great on the small plants. In 1945, there were 239 licensed fluid milk distributors in Montana and only 90 in 1951, or a reduction of 62 percent. This decrease in number of distributors was accompanied by an increase in fluid milk sales of 33 percent. Utah also experienced a decline in the number of dairy processing plants. In 1950, there were 87 plants in operation. The number in July of 1952 had declined to 81, a reduction of 6 plants

during this two-year interval. In both states it was the small processors who went out of business.

Many changes have occurred recently which appear to give large dairies a competitive advantage over the smaller plant:

1. *Introduction of paper cartons.* This type of container is more convenient to the housewife, especially for the store trade, as there are no bottles to wash or return. The initial cost and rent of paper bottling machines are high and, therefore, plants must have a sufficient volume to keep unit cost low. This volume is higher than small plants can presently sell, hence, they have lost some of the milk business where a preference exists for cartons.

2. *Improved transportation.* Nearly all communities in Utah and Montana are served by hard surfaced or good graveled roads. With good roads and efficient trucks, milk can be transported long distances at low cost. In addition, milk is being hauled in bread and other food delivery trucks to further reduce cost of transportation.

3. *Required changes in facilities.* Health departments try to improve quality of milk. Frequently, these improvements require equipment changes (e.g. pasteurizers) and improvements to other facilities. Such changes are made at the expense of plant, and if volume is low, unit costs are raised more than when volume is large.

4. *Consumer preference.* Accompanying recent changes in refrigeration, packaging, and transportation facilities, consumers appear to desire a wider variety of milk products and a more uniform quality (e. g. creamline, homogenized, low fat milk.) It is understandably more costly for many small plants to maintain uniform quality and to provide a variety of products than it is for plants with larger volume.

The cost study of small and medium-sized plants was made because in many instances small plants, especially those in outlying communities, are going out of business. This is, at least in part, a result of keen competition from the larger dairies expanding their sales territory to the area formerly served by the smaller plants. It was thought worthwhile to find out if these outlying communities are in danger of losing their milk supply from the local dairy because of excessively high unit costs and, if so, what remedies might be suggested.

Two other aspects, consumer price and quality of milk supply, were studied, to find out if major differences exist, and if, in the event one source is lost to a community, the other available source is adequate.

A cost analysis was made of nearly all of the rural fluid milk processing plants and a few selected plants of comparable size in urban areas of Utah. Four of these plants were located in Cache and

Box Elder Counties, a rural-urban area of the state (area I), 10 in Ogden, Salt Lake, Provo area, primarily urban (area II,) and 19 plants were in other parts of the state, in which the population is widely scattered and primarily rural (area III), (fig. 1). The 10 plants in the Ogden, Salt Lake, Provo area handled about 66 percent of products sold by all Utah plants included in the study. The plants in Cache and Box Elder Counties handled 13 percent of gross sales. Plants in the rest of the state handled 21 percent.

In 1947, Korzan conducted a study of processing and distribution costs in 42 plants in Montana.[5] An analysis of 9 plants randomly selected from these 42 was made in 1950. These 9 plants represent small and medium-sized fluid milk plants and are located in both urban and rural communities.

The data on which price and quality phases of this report are based were obtained from Utah. Retail prices of 119 quarts of homogenized, creamline, and premium milk were obtained from 26 communities. One hundred and thirty-one quart samples of fluid milk were obtained for quality analysis from 41 communities representing 59 fluid processing plants. These samples were analyzed by the Department of Dairy Industry, Utah State Agriculturol College.

COST OF PROCESSING AND DELIVERING MILK

SIZE AND TYPE OF FLUID MILK PLANTS[6]

THE LARGEST FLUID milk processing and delivery plants in Utah and Montana are not included in this cost study. Most of the small plants and many of the medium sized plants are included. The largest plants, which were omitted, handle several times as much grade A fluid milk as the biggest plant included. Large plants are those which each handle over 10 million pounds of grade A milk per year, medium-sized plants between 1 and 10 million, and small plants are those which handle under 1 million pounds of grade A milk.[7]

A further indication of size of plants studied, on a milk equivalent basis, is the following: The 42 Utah and Montana plants studied in 1950 processed an average of 728,000 milk equivalents annually per plant.[8] A total of 25 plants processed under 500,000 milk equivalents,

[5] Gerald E. Korzan, *Costs of distributing milk in Montana markets.* Montana Agr. Exp. Sta. Bul. 462. 1949.

[6] Throughout this publication reference to individual plants is avoided so as to prevent identification of cooperating fluid milk plants.

[7] See explanation of grade A and grade C milk in appendix.

[8] See footnote 1.

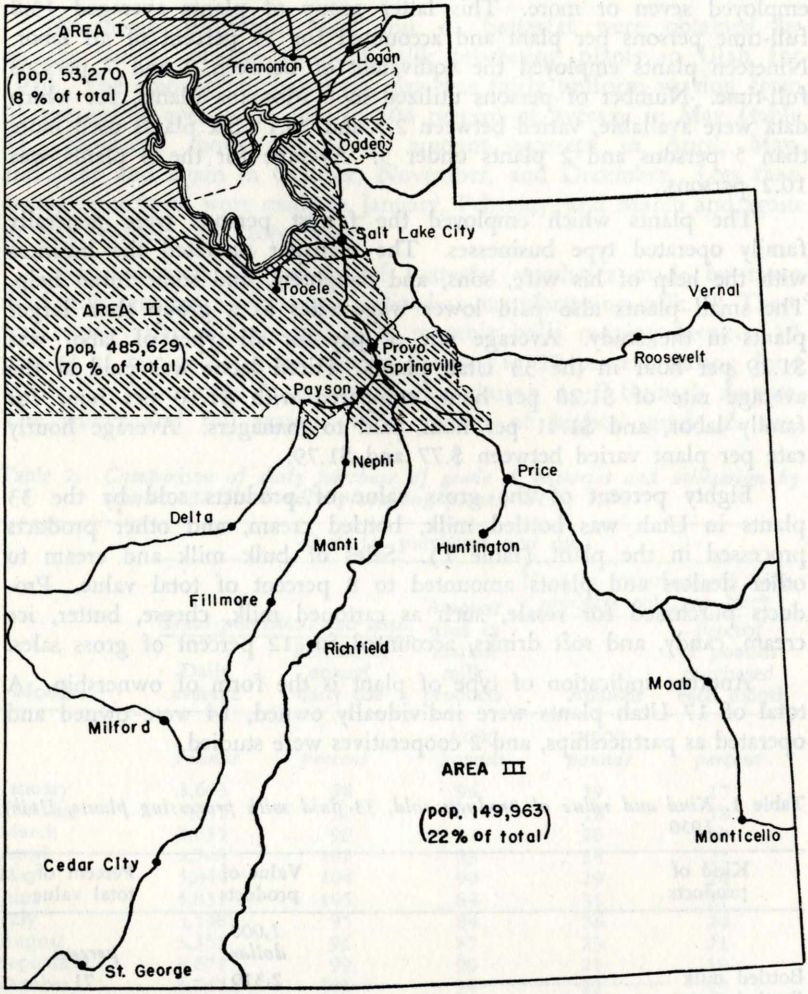

Fig. 1. Milk producing areas in Utah used in this report

8 plants between 500,000 and 1,000,000, and 9 plants processed over 1,000,000 milk equivalents.

The Utah plants employed an average of 5.6 full-time man-equivalents.[9] This included operator's time, hired, and family labor.

[9] For purposes of this study, 2,200 man-hours of work per year, 44 hours for 50 weeks, was considered a full-time equivalent.

Seven plants had less than two full-time persons and seven plants employed seven or more. This latter group of plants averaged 13.8 full-time persons per plant and accounted for 53 percent of all labor. Nineteen plants employed the equivalent of between 2 and 7 persons full-time. Number of persons utilized in 8 Montana plants, for which data were available, varied between 2.5 and 20.1 Six plants used more than 5 persons and 2 plants under 5. Average for the 8 plants was 10.2 persons.

The plants which employed the fewest persons were generally family operated type businesses. The manager operated the business with the help of his wife, sons, and daughters, and some hired help. The small plants also paid lower wage rates as a group than larger plants in the study. Average rate of pay for all types of labor was $1.29 per hour in the 33 Utah plants. Hired labor was paid at the average rate of $1.28 per hour, compared with $1.10 per hour for family labor, and $1.41 per hour paid to managers. Average hourly rate per plant varied between $.77 and $1.79.

Eighty percent of the gross value of products sold by the 33 plants in Utah was bottled milk, bottled cream, and other products processed in the plant (table 1). Sales of bulk milk and cream to other dealers and plants amounted to 8 percent of total value. Products purchased for resale, such as cartoned milk, cheese, butter, ice cream, candy, and soft drinks, accounted for 12 percent of gross sales.

Another indication of type of plant is the form of ownership. A total of 17 Utah plants were individually owned, 14 were owned and operated as partnerships, and 2 cooperatives were studied.

Table 1. *Kind and value of products sold, 33 fluid milk processing plants, Utah, 1950*

Kind of products	Value of products	Percent of total value
	1,000 dollars	*percent*
Bottled milk	2,319	71
Bottled cream	195	6
Bulk cream or milk*	247	8
Other products processed by plant†	103	3
Products purchased for resale‡	381	12
Total	3,245	100

* Sold to other plants and processors as bulk milk or cream.

† Includes cottage cheese, ice cream, chocolate, yogurt, skim milk, and orange.

‡ Includes products not processed by plant such as cartoned milk, supplies bought for resale, cheese, butter, ice cream, and candy.

PURCHASE AND SALE OF MILK

Purchases, utilization, and cost of butterfat were obtained by months for 31 of the 33 fluid milk processing plants in Utah for 1950. The amount purchased per day was fairly uniform varying from 95 percent of average in July to 104 percent of average in May (table 2). Purchases above average in amount occurred in April, May, and June and again in October, November, and December. Less than average purchases were made in January, February, and March and again in July, August, and September.

Approximately 20 percent of butterfat purchases made by these fluid milk processing plants was utilized as manufacturing milk. [10] There was some variation from this on a monthly basis ranging between 17 percent of non-grade A use during January to 27 percent during June (table 2). Non-grade A use was highest during April through August. The winter and fall seasons were periods of highest grade A use.

Table 2. *Comparison of daily purchase of grade A butterfat and utilization by months, 31 fluid milk processing plants, Utah, 1950*

Month	Butterfat purchased and used				
	Total purchased and used		Amount used in market milk products	Used in manufactured milk products sold, or lost*	
	Daily average	Percent of annual daily use		Amount	Percent of pounds purchased each month
	pounds	*percent*	*1,000 pounds*	*1,000 pounds*	*percent*
January	3,643	98	94	19	17
February	3,655	99	85	18	18
March	3,635	98	92	20	18
April	3,763	102	89	24	21
May	3,844	104	90	29	24
June	3,831	103	84	31	27
July	3,538	95	84	26	24
August	3,555	96	87	23	21
September	3,677	99	90	21	19
October	3,747	101	94	22	19
November	3,810	103	93	21	18
December	3,768	102	96	21	18
Average	3,705	100	90	23	20

* Includes butterfat sold to other dealers, amounts used in products not requiring grade A milk, and estimated amounts lost in processing and delivery. Sales to other dealers were made at the grade C or manufacturing price.

[10] For all 33 plants a total of 70 percent of butterfat purchases was used in bottled milk, 10 percent in bottled cream, 17 percent was sold in bulk form to other dealers, and 3 percent was used for other purposes or lost in processing and delivery.

Table 3. *Prices per pound of grade A butterfat by months, 33 fluid milk processing plants, Utah, 1950*

Month	Prices paid per pound butterfat			Percent of annual price paid
	Lowest plant	Highest plant	Average all plants	
	dollars	*dollars*	*dollars*	*percent*
January	.91	1.60	1.19	101
February	.94	1.60	1.19	101
March	.93	1.60	1.16	98
April	.92	1.45	1.12	95
May	.92	1.45	1.10	93
June	.94	1.41	1.10	93
July	.94	1.40	1.14	97
August	.97	1.43	1.19	101
September	.96	1.43	1.21	102
October	.93	1.43	1.26	107
November	.93	1.43	1.25	106
December	.97	1.40	1.23	104
Average	-----	-----	1.18	100

Average monthly prices paid per pound of butterfat at the farm varied from $1.10 to $1.26 or a $.16 difference (table 3). Highest prices were paid during the fall and winter months and lowest prices in the spring and early summer months when production was highest.

There was considerable variation in prices paid for butterfat. The lowest price paid was $.91 per pound compared with a high of $1.60. These are prices at the plant, cost of transportation being included. An estimated transportation cost was added where no hauling charge was made by the plant. Otherwise the actual amount charged for transportation was added to the price of milk. Only 3 plants paid an average price in 1950 of $1.00 or less while 6 plants paid $1.25 or more per pound butterfat for grade A milk.

Plants in areas I and II (fig. 1) paid more uniform prices for milk than those in the more sparsely populated area III. In the first 2 areas all but one plant followed Federated Milk Producers Association in establishing their prices to producers.[11] Price differences on a butterfat basis were therefore largely a result of differences in butterfat test, utilization, and transportation costs of the milk.

In area III there was considerable variation in the price paid producers for grade A milk. In some cases producer prices were con-

[11] The Federated Milk Producers Association is a cooperative bargaining agency representing grade A milk producers in Utah supplying milk to the greater Salt Lake metropolitan area. This association has authority to negotiate and fix all the terms and conditions surrounding the sale, delivery, and payment of members' milk.

siderably above the prices which would have been paid if the plant had followed Federated. A variety of different bases were used to price milk in area III. Eight of the 19 plants studied in this area followed Federated or at least used it in their pricing formula. One plant paid 55 percent of the delivered retail price per quart and another plant paid 50 percent of the per quart wholesale price. Nine plants negotiated the price with individual producers using no established formula, but relying on what other grade A and grade C users of milk were paying and the bargaining ability of themselves and producers.

COST COMPARISON, UTAH AND MONTANA

The most important cost item for the 33 plants in Utah was milk and cream purchases. More than half or 55 percent of total expenses was for purchase of these two products. The second most important cost item was for labor, accounting for 19 percent of total costs, two-thirds of which was for hired labor. This was followed by expenditures for other products purchased for resale and container costs, both together accounting for 14 percent of the total. Truck and auto expense was 4 percent of costs and all other costs were 8 percent.

Average operating costs which includes processing, delivery, and administration were substantially higher for small and medium-sized plants in Utah than Montana.[12] These costs averaged 5.29 cents per quart of milk equivalent for Utah plants, 4.71 cents for the 9 Montana plants studied in 1950, and 5.00 cents for the 42 Montana plants studied in 1947 (table 4).

Table 4. *Processing, distribution, and administration costs per quart of milk equivalent, Utah and Montana plants, 1947-1950*

Cost item	Average cost per milk equivalent			Average cost, Utah-Montana, 1950	
	Montana 42 plants 1947*	Montana 9 plants 1950*	Utah 33 plants 1950	Combined average cost	Percent of total
	cents	*cents*	*cents*	*cents*	*percent*
Processing	2.50	2.36	2.38	2.37	47
Sales and delivery	1.88	1.73	2.37	2.12	42
Administration	0.62	0.62	0.54	0.57	11
Total	5.00	4.71	5.29	5.06	100
Average number milk equivalents processed per plant (000)	637	1,394	546	.....	.....

* No adjustments for price level changes were made between these two years.

[12] See appendix for explanation of processing, delivery, and administration costs.

Most of the difference in operating costs between these three groups of plants occurred in the distributing function. It is possible that this difference is accounted for by the variation in the number of milk distributors serving a given area. There was a decrease in the number of milk distributors in Montana between 1947 and 1950, which should result in less duplication of services in the latter time period. Partial evidence also indicates that there was less duplication of services in Montana in 1947 than was true in Utah during 1950.

In 1950, processing costs for all plants were 47 percent of total operating costs. Delivery costs were 42 percent, and administrative costs 11 percent.

Efficiencies of a substantial nature would be necessary in processing, delivering, and administration to enable fluid milk processing plants materially to reduce the cost of milk to the consumer. For example, a 20 percent reduction in these costs would be required to reduce the retail price of each quart of milk approximately one cent. If all administrative costs were eliminated, price of milk could only be reduced about one-half cent.

Labor was the largest item of this expense, accounting for 59 percent of the combined processing, delivery, and administrative costs. Truck costs were next in importance amounting to 13 percent of all

Table 5. *Processing costs per quart of milk equivalent, Utah and Montana plants, 1947-1950*

Cost item	Average processing cost per milk equivalent			Average cost, Utah-Montana, 1950	
	Montana 42 plants 1947	Montana 9 plants 1950	Utah 33 plants 1950	Costs per milk equivalent	Percent of total
	cents	*cents*	*cents*	*cents*	*percent*
Labor	1.26	0.88	1.16	1.05	44
Depreciation:					
Buildings	0.07	0.04	0.05	0.04	2
Equipment	0.22	0.13	0.19	0.17	7
Total	0.29	0.17	0.24	0.21	9
Utilities	0.23	0.15	0.23	0.20	8
Taxes, insurance	0.11	0.19	0.08	0.13	5
Repairs	0.21	0.14	0.13	0.14	6
Supplies	0.23	0.26	0.14	0.19	8
Interest	.....	0.14	0.17	0.15	7
Miscellaneous*	0.17	0.43	0.23	0.30	13
Total	2.50	2.36	2.38	2.37	100

* Cost of milk loss, freight, inspection fees, business licenses, and auto and truck expense chargeable to processing. The 1950 Montana data include costs for royalties, machine and building rental, and storage costs under miscellaneous. These latter expenses for Utah plants were included under building and equipment and supply costs.

costs followed by depreciation on equipment and buildings, which was 4 percent.

Processing costs in Utah and Montana amounted to 2.38 and 2.36 cents per milk equivalent, respectively (table 5). The largest cost item was labor amounting to 44 percent of processing. This would appear to be the first item to analyze in trying to improve plant efficiency. Utilities and supplies each amounted to 8 percent of total processing costs. Depreciation on buildings and equipment chargeable to processing operations amounting to 9 percent.

Truck costs nearly one-third of delivery costs. Truck costs amounted to 31 percent of total delivery costs and labor 63 percent or a combined total of 94 percent of the delivery function (table 6). Bad debt loss appeared not to be a major cost item in both states amounting to only 0.03 of a cent per milk equivalent or 1 percent of all delivery costs. Advertising costs were 0.06 of a cent per milk equivalent in Utah compared with 0.13 of a cent in Montana. These costs were 4 percent of total delivery costs.

Table 6. *Delivery cost per quart of milk equivalent, Utah and Montana plants, 1947-1950*

Cost item	Delivery costs per milk equivalent			Average cost, Utah-Montana, 1950	
	Montana 42 plants 1947	Montana 9 plants 1950	Utah 33 plants 1950	Cost per milk equivalent	Percent of total
	cents	*cents*	*cents*	*cents*	*percent*
Labor	1.11	0.96	1.56	1.33	63
Truck	0.56	0.60	0.69	0.65	31
Bad debt loss	0.04	0.03	0.03	0.03	1
Advertising	0.14	0.13	0.06	0.09	4
Miscellaneous*	0.03	0.01	0.03	0.02	1
Total	1.88	1.73	2.37	2.12	100

* Includes supplies, depreciation on buildings, and equipment chargeable to delivery costs, and other minor expenses.

Administrative costs about one-half-cent per quart of milk. The cost of administration averaged 0.57 cents per quart of milk equivalent for all plants studied in the two states. Labor amounted to 76 percent of the total administrative cost and office supplies, postage, and telephone, 9 percent. The remaining administrative expense consisted of legal and accounting fees, donations, dues, subscriptions, business license, and inspection fees and other minor items. Any major increase in administrative efficiency would have to occur in more efficient use of labor because it amounted to such a high portion of total administrative costs.

Table 7. *Variation in volume processed, capital and labor costs, time spent processing, and wage rates, according to range in processing costs, 33 fluid milk processing plants, Utah, 1950*

Factor	Costs per quart of milk equivalent							
	Processing under 200,000 milk equivalents			Processing between 200,000 and 600,000 milk equivalents			Processing over 600,000 milk equivalents	
	Under 2.4 cents	Between 2.4 and 5.0 cents	Over 5.0 cents	Under 2.4 cents	Between 2.4 and 5.0 cents	Over 5.0 cents	Under 2.4 cents	Between 2.4 and 5.0 cents
	2 plants	*6 plants*	*3 plants*	*5 plants*	*7 plants*	*1 plant*	*7 plants*	*2 plants*
Average processing costs per quart of milk equivalent (cents)	2.2	4.0	5.6	2.3	3.0	5.5	1.9	2.8
Average number of quarts of milk equivalents processed (000)	157	133	115	364	326	216	1,505	867
Average value of capital used in processing per quart of milk equivalent (cents)	3.8	6.1	13.7	3.5	5.4	15.6	2.5	1.7
Average time spent processing per quart of milk equivalent (seconds)	43	80	98	32	47	69	25	48
Average hourly rate paid labor used in processing (dollars)	.89	.94	.97	1.08	1.08	1.00	1.39	1.17
Average processing labor cost per quart of milk equivalent (cents)	1.1	2.1	2.6	1.0	1.4	1.9	1.0	1.6

REASONS FOR LOW UNIT OPERATING COSTS

One purpose of this study was to isolate and to analyze factors making for plant efficiency.

Reason for low processing costs. The 33 Utah plants were divided into groups according to number of quarts of milk equivalents processed yearly. There were 11 plants processing less than 200,000 milk equivalents, 13 between 200,000 and 600,000, and 9 plants more than 600,000 quarts (table 7). The plants were further subdivided within these size groupings according to unit processing costs. The average performance of the plants falling within the respective size and cost groupings was then calculated for the following factors: (I) average processing costs per quart of milk, (2) average number of quarts of milk equivalents processed, (3) average value of capital used in processing per quart of milk equivalent, (4) average time spent processing per quart of milk equivalent, (5) average hourly rate paid labor used in processing, and (6) average processing labor cost per quart of milk equivalent.

The 11 smallest plants processed at an average cost of 4.0 cents. This was twice as high as the 9 largest plants surveyed which had costs of 2.0 cents per quart of milk equivalent. Per unit processing costs were 2.9 cents for the 13 medium sized plants. Average costs for all plants were 2.4 cents. It should be noted that these costs do not include procurement costs which may be somewhat higher for the larger plants.

There was considerable cost variation in unit cost within each of these size groupings. Among the 11 smallest plants two had processing costs under the average for all plants of 2.4 cents. Six of these plants had costs between 2.4 and 5 cents, and 3 had costs above 5 cents per quart of milk equivalent. Among the 9 largest processing plants, 7 had costs under the average of 2.4, 1 plant had a cost of 2.6, and another of 3.0 cents. Five of the medium-sized plants had costs under 2.4 cents, 7 had costs between 2.4 and 5 cents, and 1 plant's costs were above 5 cents (table 7). Similar variation was found in the study made by Korzan referred to earlier.

Within each of these size groupings average number of milk equivalents processed declined as unit costs increased. Volume among the 11 small plants declined from 157,000 milk equivalents per plant to 115,000 as costs per plant increased from less than 2.4 cents to more than 5.0 cents. A similar relationship existed for the medium and large sized plants.

Capital valuation per quart of milk equivalent approximately doubled as per unit processing costs increased among the small and medium-sized plants from less than 2.4 to more than 5.0 cents.

Time spent processing within each of the small, medium, and large size groups of plants also approximately doubled as processing costs increased from less than 2.4 to more than 5.0 cents.

Among the smallest sized plants, as processing costs increased hourly wage rates also increased. The rate was $.89, $.94, and $.97 cents for plants as average processing costs changed fram 2.2, 4.0, and 4.6 cents, respectively. Hourly wage rates declined among the medium and large sized plants as unit processing costs increased, indicating that reduced labor rates in these larger plants did not result in lower unit cost of processing.

Unit labor cost of processing approximately doubled as all processing costs per milk equivalent increased from less than 2.4 to more than 5.0 cents. For example, among the 11 smallest plants, two had processing costs less than 2.4 cents and labor costs of 1.1 cents. Six plants had processing costs between 2.4 and 5.0 cents and labor costs averaging 2.1 cents and in 3 plants processing costs were more than 5.0 cents, and labor costs averaged 2.6 cents per milk equivalent (table 7).

The above analysis shows that the plants with lowest unit cost also: (1) were the largest plants in terms of quarts of milk equivalents processed, (2) had the lowest valuation of capital per quart of milk equivalent, (3) spent the shortest time processing per quart of milk equivalent.

Large savings possible through lower unit costs. These differences in unit processing costs are a potential source of large savings to fluid milk processing plants. For example, a small plant, processing 200,000 milk equivalents per year at the average cost for these small plants of 4 cents, could save $4,000 annually, if its costs could be reduced to 2 cents per quart of milk equivalent. This latter unit cost is the same as the average for the largest plants processing 600,000 and more quarts of milk equivalent per year.

A plant processing 1,000,000 milk equivalents annually could save $10,000 by reducing its costs of processing 1 cent per quart. This increased efficiency does not appear outside the realm of possibility when we consider that there was a difference in unit processing costs between the high and low cost plants of 1.4 cents for the largest and 3.9 cents for the smaller plants.

Plants with highest capital value per milk equivalent had higher costs. There was considerable variation in the amount of capital invested in each plant; for example, one small plant had a valuation of 23.0 cents per quart of milk equivalent processed, whereas, one of the larger, better-equipped plants had a valuation of only 1.2 cents per quart.[13] Average

[13] Value of capital was obtained from reports prepared for the Bureau of Internal Revenue by the plant operators.

capital valuation was 3.4 cents per quart of milk equivalent. Because of this variation in capital among plants, and because major capital costs, interest and depreciation, amounted to 16 percent of processing, the relation between capital valuation and processing costs was analyzed. Plants were subdivided so as to separate, insofar as possible, the influence of volume of processing from capital valuation on unit processing costs.

Processing costs increased as valuation per quart of milk equivalent increased. These costs were 2.0 cents for plants with a valuation of from 1 to 2 cents per quart of milk equivalent, and 2.6 cents for plants with a valuation of from 3 to 4 cents. Processing costs were 3.3 cents for the 7 plants which had a valuation of from 5 to 6 cents, and 4.8 cents for plants with a valuation of more than 7 cents (table 8).

Table 8. *Relationship of value of capital used in processing, to processing costs per milk equivalent, and number of milk equivalents, 32 fluid milk processing plants, Utah, 1950**

Number of milk equivalents	Average plant costs per milk equivalent									
			Value of capital per milk equivalent							
	All plants		One-two		Three-four		Five-six		Seven over	
	No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost
		cents		*cents*		*cents*		*cents*		*cents*
Under 200,00	11	4.0	....	....	3	2.6	4	4.1	4	4.9
200,000 - 400,000	9	3.0	2	2.4	3	2.9	2	2.5	2	4.6
400,000 - 600,000	3	2.8	....	....	2	2.6	1	3.2	....	.....
600,000 - and over	9	2.0	8	2.0	1	2.1	....	....	....	.....
Average	32	2.4	10	2.0	9	2.6	7	3.3	6	4.8

* One plant omitted because of equipment rental. Capital valuation is the operator's estimate, for income tax purposes, of the average 1950 valuation of land, buildings, and equipment used in processing.

This relationship between increasing processing costs and capital valuation held when plants were subdivided according to number of milk equivalents processed. The 11 small plants processing under 200,000 milk equivalents had average processing costs of 4.0 cents. The unit cost increased among these 11 plants from 2.6 cents to 4.9 as capital valuation increased from 1 to more than 7 cents. For the 9 plants processing between 200,000 and 400,000 milk equivalents, cost of processing increased from 2.4 cents to 4.6 as valuation increased. A similar relationship was found for the plants in the two larger size groupings (table 8).

Higher investment per unit of output resulted in higher total unit processing costs. Apparently this higher unit investment did not enable the plant managers to offset the resulting higher capital costs such

as depreciation, interest, taxes, insurance, and repairs with lower unit labor, and other variable costs.

Largest plants most efficient in use of labor and capital. Processing costs were further analyzed to ascertain the relationship between unit processing costs, capital valuation per quart of milk equivalent, and time spent processing. It was apparent that the most efficient, or plants with lowest per unit cost, made better use of capital and labor and were generally the largest plants, thus indicating again the importance of volume in obtaining low unit cost of processing.

Table 9. *Relation of value of capital used in processing, time spent processing, and processing costs, 11 fluid milk plants processing under 200,000 milk equivalents, per plant, Utah, 1950*

Value of capital per milk equivalent	Average plant cost per milk equivalent							
			Seconds per milk equivalent					
	All plants		Under 40		40 to 60		60 and over	
Range in cents	No.	Cost	No.	Cost	No.	Cost	No.	Cost
Three to four	3	2.6	....	.....	2	2.2	1	4.2
Five to six	4	4.1	....	.....	....	....	4	4.1
Seven and over	4	4.9	.....	.....	1	3.3	3	5.6
Average or total	11	4.0	....	.....	3	2.6	8	4.6

The 11 plants processing less than 200,000 quarts were subdivided according to capital valuation and time spent per quart of milk equivalent. Plant costs ranged from 2.6 to 4.9 cents per quart as capital valuation increased from 3 to 7 or more cents (table 9). Three of the 11 plants spent between 40 and 60 seconds processing per quart of milk equivalent and had costs of 2.6 cents, while 8 plants

Table 10. *Relation of value of capital used in processing, time spent, and costs, 9 fluid milk plants processing between 200,000 and 400,000 milk equivalents, per plant, Utah, 1950*

Value of capital per milk equivalent	Average plant cost per milk equivalent							
			Seconds per milk equivalent					
	All plants		Under 40		40 to 60		60 and over	
Range in cents	No.	Cost	No.	Cost	No.	Cost	No.	Cost
One to two	2	2.4	1	2.3	1	2.4	....	.....
Three to four	3	2.9	1	2.6	1	3.2	1	3.2
Five to six	2	2.5	1	2.2	1	3.0	....	.....
Seven and over	2	4.6	....	....	....	....	2	4.6
Average or total	9	3.0	3	2.4	3	2.7	3	4.1

spent 60 seconds or more and had average costs of 4.6 cents. None of these smallest plants had a capital valuation of less than 3 cents or spent less than 40 seconds per quart processing milk.

A similar relationship occurred among the 9 plants processing between 200,000 and 400,000 milk equivalents. Processing costs, however, were generally lower for this group of plants compared with the 11 smallest (table 10). Two of these 9 plants had a capital valuation under 2 cents and of these 1 plant spent less than 40 seconds processing with unit costs of 2.3 cents and 1 plant used between 40 and 60 seconds processing with unit costs of 2.4 cents. Three plants had a capital valuation of 3 to 4 cents. One of these spent less than 40 seconds per quart processing with costs of 2.6 cents. The two which spent more than 40 seconds processing had costs of 3.2 cents. Two plants had a valuation of between 5 and 6 cents. One of these plants spent less than 40 seconds processing and had costs of 2.2 cents, while 1 plant spent between 40 and 60 seconds processing and had costs of 3.0 cents. Two plants had a valuation of 7 or more cents and spent 60 or more seconds per unit processing and had costs of 4.6 cents per milk equivalent.

There were 3 plants which processed between 400,000 and 600,000 milk equivalents. Here again the data indicate that the plants with lowest unit value of capital and least time spent processing also had the lowest unit processing costs (table 11).

Table 11. *Relation of value of capital used in processing, time spent, and costs, 3 fluid milk plants processing between 400,000 and 600,000 milk equivalents, Utah, 1950*

Value of capital per milk equivalent	Average plant cost per milk equivalent					
	Seconds per milk equivalent					
	All plants		Under 40		40 to 60	
Range in cents	No.	Cost	No.	Cost	No.	Cost
		cents		*cents*		*cents*
Three to four	2	2.6	2	2.6	----	----
Five to six	1	3.2	----	----	1	3.2
Average or total	3	2.8	2	2.6	1	3.2

The 9 largest plants processed 600,000 or more milk equivalents. Eight of these plants had a valuation of under 3 cents per quart and had processing costs of 2.0 cents (table 12). Seven plants in this group spent under 40 seconds processing and had costs of 1.9 cents per quart compared with the remaining plant which spent more than 60 seconds and had costs of 3.0 cents per quart. One plant had a unit valuation of between 3 and 4 cents and spent under 40 seconds per quart of milk processed. This plant had average processing costs of 2.1 cents.

Table 12. *Relation of value of capital used in processing, time spent, and processing costs, 9 fluid milk plants processing 600,000 or more milk equivalents, Utah, 1950*

Value of capital per milk equivalent	Average plant cost per milk equivalent							
	Seconds per milk equivalent							
	All plants		Under 40		40 to 60		60 and over	
Range in cents	No.	Cost	No.	Cost	No.	Cost	No.	Cost
		cents		*cents*		*cents*		*cents*
One to two	8	2.0	7	1.9	....	.....	1	3.0
Three to four	1	2.1	1	2.1	....	.....	....	....
Average or total	9	2.0	8	2.0	....	.....	1	3.0

Small and large plants have similar delivery costs. Unlike processing costs delivery costs did not decline as volume increased, but showed no particular relationship to number of units delivered. Delivery costs averaged 2.4 cents per quart of milk equivalent (table 13). The 12

Table 13. *Relation of number of local wholesale and retail delivery milk equivalents to per unit delivery costs, and wage rates, 33 fluid milk plants, Utah 1950*

Delivery milk equivalents	Average delivery costs per milk equivalent							
	Wage rates paid delivery employees							
	All plants		Under $1.00		$1.00 to $1.25		Over $1.25	
	No.	Cost	No.	Cost	No.	Cost	No.	Cost
		cents		*cents*		*cents*		*cents*
Under 200,000*	12	2.3	4	2.2	5	2.3	3	2.2
200,000 - 400,000	8	2.2	2	2.3	6	2.1	..	....
400,000 - 600,000	4	3.2	..	....	3	3.3	1	2.6
600,000 - and over	9	2.3	..	....	1	1.8	8	2.3
Average all plants	33	2.4	6	2.3	15	2.5	12	2.3

* Numbers of delivery and processing milk equivalents were calculated separately, hence the reason for a different number of plants within the groups. Refer to appendix for further explanation.

smallest plants delivering under 200,000 milk equivalents in 1950 had delivery costs of 2.3 cents. Eight plants which delivered from 200,000 to 400,000 milk equivalents had costs of 2.2 cents compared with costs of 3.2 cents for the four next largest plants and costs of 2.3 cents for the plants delivering 600,000 or more milk equivalents.

There likewise was no relation between wage rates and unit delivery costs. A total of 6 plants paid under $1.00 per hour to labor used in delivery functions. These plants had costs of 2.3 cents per milk equivalent compared with 2.5 cents for the 15 plants paying delivery help from $1.00 to $1.25 per hour. Plants that paid more

than $1.25 per hour sold and delivered milk for 2.3 cents per quart of milk equivalent.

Labor made up 63 percent of all delivery costs, hence there were factors to offset these higher wage rates. Otherwise unit delivery costs would have increased as higher wage rates were paid. Such factors were frequency of delivery stops, number of units delivered per stop, distance traveled per unit delivered, method of collections, and number and kind of special services. No attempt was made in this study to analyze the influence of these factors on unit delivery costs. Those interested in these relationships may obtain further information from Korzan's study referred to earlier.

Administrative costs tend to increase as size of plant increases. The smallest plants had administration costs of 0.41 of a cent per quart of milk equivalent, and the largest plants 0.57 of a cent. Plants which processed between 200,000 and 400,000 milk equivalents had administrative costs of 0.53 of a cent, and those which processed between 400,000 and 600,000 equivalents had costs of 0.43 of a cent.

PRICES OF FLUID MILK IN UTAH MARKETS

A STUDY OF retail prices of fluid milk was made in the different communities of Utah. Prices were for quarts of creamline, homogenized, and premium milk sold from grocery stores and cafes, placed on the doorstep, and sold from the retail sales counter at the dairy plant. Prices for the three months of November 1951 through January 1952 were based on 119 samples of milk obtained in 26 communities. During this 3 month period no general change in retail milk prices occurred.

Prices were the standard or most typical charged by each dairy. No information on special pricing practices such as discounts for quantity purchases, and rebates, was obtained. Undoubtedly, some milk was available at prices different from those found by the enumerators. Several stores and most of the processing plants in each area were visited, hence, it is believed the most typical prices were obtained.

PRICE DIFFERENCES AMONG COMMUNITIES

Prices of fluid milk, sold in the various communities of the state from which samples were obtained, varied between 16 and 23 cents (fig. 2). The 16 cent milk was creamline, home-delivered milk supplied by a small local dairy. The 23 cent milk was homogenized, cartoned, and sold in a grocery store supplied by a dairy plant located 250 miles away. This actually amounts to more than a 7 cent differential

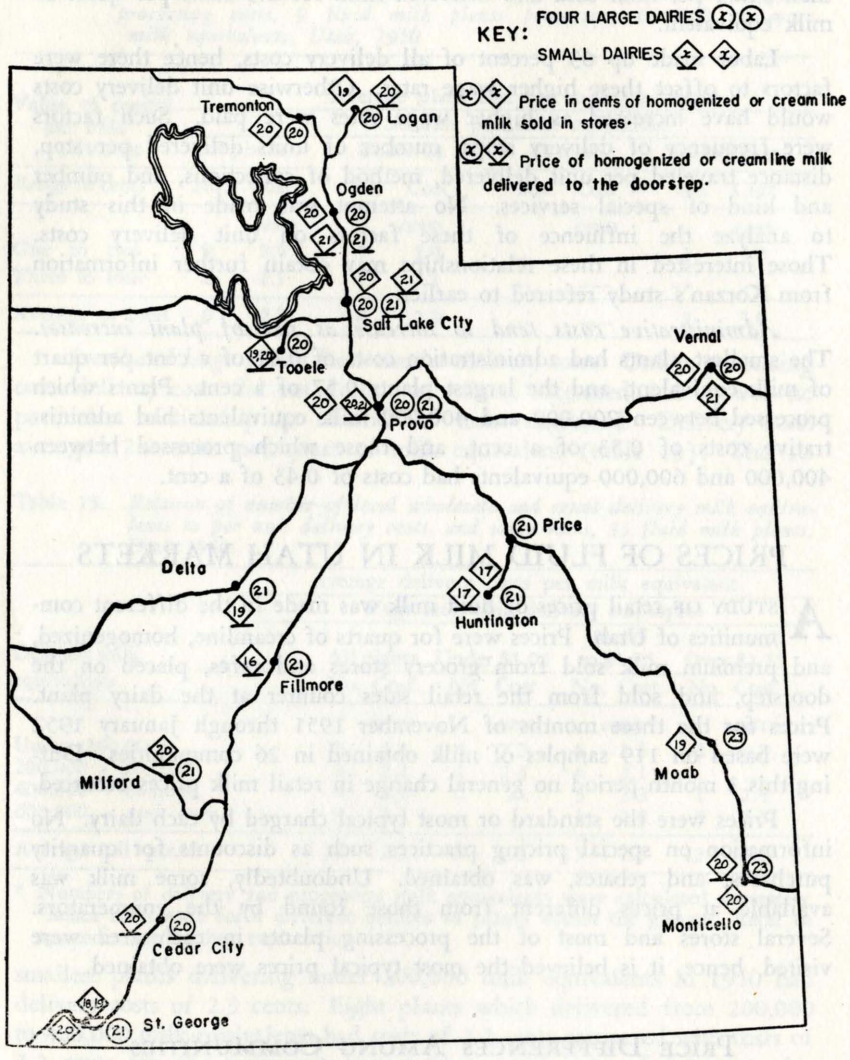

Fig. 2 Prices of milk found in selected communities of Utah in November of 1951 through January 1952

because the lower priced milk was home-delivered whereas the 23 cent milk was sold through grocery stores. Within the same communities, price differentials of up to 5 cents were found between these two sources and kinds of milk.

LITTLE PRICE VARIATION IN URBAN AREAS

There was relatively little variation in prices of milk found in Cache and Box Elder Counties (area I), and the Ogden, Salt Lake, Provo area (area II).[14] The most typical prices of homogenized and creamline milk, placed on the doorstep, in all communities in these two areas was 20 or 21 cents. A price of 21 cents was typically charged in Ogden, Salt Lake, and Provo where the large dairies delivered milk to the doorstep. The smaller dairies in the communities in areas I and II, outside of these three cities, typically delivered milk to the doorstep for 20 cents. However, one small dairy was found which made deliveries for 19 cents.

Milk sold in stores in area I and II by the large dairy plants was uniformly priced at 20 cents. In every case this was homogenized milk sold in paper cartons. Small dairies, located in these two areas, also typically sold milk through stores for a price of 20 cents; however, in two communities this milk sold for 19 cents.

The uniformity of milk prices found in these two areas probably resulted primarily from price leadership on part of the large firms, and the influence of the Federated Milk Producers Association in negotiating prices of fluid milk purchased from farmers by most of the dairies located in these two areas.

WIDE PRICE VARIATION IN RURAL AREAS

In the more sparsely settled regions of the state (area III), prices of fluid milk varied widely. As a rule, milk shipped in from the 4 largest plants was retailed from stores for between 21 and 23 cents depending on distance from the shipping plant. Milk furnished by small local dairies in area III was retailed by stores for between 17 and 20 cents, with 20 cents being the most typical price. Most of the milk sold by stores in area III was supplied by the large outside dairies while local plants made the doorstep deliveries.

Milk from local plants in area III was delivered to the doorstep for between 16 and 21 cents. The price of 20 cents was most typical; however, several instances were found where home delivered milk sold for 18 or 19 cents. No instances were found where shipped-in milk was delivered to the doorstep by routemen employed by one of the 4 largest dairies. In a few communities, however, one of the 4 large daries sold milk wholesale to the local plant manager who in

[14] Refer to fig. 1. The Cache and Box Elder County area is rural-urban, the Ogden, Salt Lake, and Provo area is primarily urban, and the rest of the state is sparsely settled and primarily rural.

turn delivered this paper-cartoned product along with his own at the usual higher price for shipped-in milk.

Local plants were finding that the cartoned milk sold in grocery stores from the large outside dairies was offering keen competition to their glassed product. This was true even in the rural communities where price differentials of up to 5 cents were found. It appeared that the local milk was not preventing sales of relatively large amounts of cartoned milk irregardless of the then existing price differentials. Apparently, some consumers are influenced more by type of container, uniformity of quality, convenience of not washing and returning bottles, and brand names than they are with home deliveries and price differentials.

QUALITY OF FLUID MILK SUPPLIED UTAH COMMUNITIES

TO ASCERTAIN the quality of milk being sold, 131 quart samples of fluid milk were obtained from 41 communities in Utah during the three month period of November, December 1951 and January 1952.[15] These samples were taken from processing plants, grocery stores, cafes, and delivery trucks. They represent milk from 59 fluid milk processing plants. One or more samples of milk were obtained from local processing plants selling milk in each of the 41 communities.

Samples were obtained on an area basis from the 4 largest dairies. It was deemed unnecessary to obtain this milk from the same dairy in every community where it was sold.

Precautions were taken to insure that samples obtained for analysis were representative of milk sold to the public. Dairies, grocery stores, and cafes were not notified that samples were to be obtained. They were taken from the store's cold shelf, delivery truck, or the dairy, at random. In taking samples from the store's cold shelf generally one was taken from the front row and one from the back row so as to obtain samples from the most recent and the oldest milk, it being a practice of the delivery man to place the new deliveries in back of the previously delivered milk. All samples were treated in the same manner. Identification of each sample was not known while laboratory anaylsis was being made.

The quality analyses were made by the Department of Dairy Industry, Utah State Agricultural College. Each sample was checked for bacteria count, flavor and odor, sediment, temperature, container and

[15] Assisting on this phase of the study were the Department of Dairy Industry of the Utah State Agricultural College, the State Department of Agriculture, and local health departments.

closure, and scored according to the recommendations of the American Dairy Science Association.

In addition to these factors, samples were tested for phosphatase, coliform bacteria, fat content, and added water. [16]

Purposes of this study were (1) to compare quality of fluid milk available to rural and urban areas; (2) to compare quality supplied by local plants with milk sold by the 4 largest dairies which ship milk to outlying communities; (3) to ascertain quality of fluid milk sold by the various dairies so they could compare their product with other plants and thereby have a better basis for improving it.

SIMILAR QUALITY MILK AVAILABLE IN RURAL AND URBAN AREAS

There was little difference in quality of milk available to consumers in each of the three areas. All but a few small isolated communities had milk available from both the 4 largest dairies and the smaller local plants. Average score of milk from the 4 largest dairies was 94.3 in the Box Elder-Cache County area, 91.4 in the urban area of Ogden, Salt Lake, and Provo, and 92.9 in the rest of the state. This compares with average scores from the smaller, local dairies in each of the areas of 88.7, 89.0, and 88.3, respectively (table 14).

Average bacteria score for all samples was 30.9 with 35 possible. This factor accounted for 4.1 points of the 10.4 point difference between the over-all average score of 89.6 and a perfect score of 100.

Flavor scores averaged 39 out of a possible 45 and accounted for 6 points of the 10.4 point difference between average and perfect total scores. Flavor scores were more uniform than bacteria scores, ranging from 35 to 41, compared with a range between bacteria scores of from 0 to 35.

Milk is considered excellent if it has a total score of 95. Likewise flavor is considered excellent if it has a flavor score of 40. This 5 point difference between the maximum flavor score of 45 and an excellent score of 40 represents the difference between perfection in the

[16] Bacteria counts were made by the plate method which indicates sanitary quality of milk. Kind of bacteria is actually more meaningful, as only pathogenic bacteria are harmful and these are a source of potential danger to human health regardless of number appearing in milk supply. Flavor is an indication of palatability of milk and was ascertained by 3 impartial judges. Sediment is an indication of the way milk was handled following pasteurization. Container and closure are indications of protection. The container provides against quality deterioration. Phosphatase is an indication of efficiency of pasteurization. Coliform count was made by the plate method and indicates freedom from post pasteurization contamination.

Table 14. *Quality of fluid milk compared with area and source of supply, Utah, 1950-52*

Area	Number of samples	Quality scores*			
		Bacteria	Flavor	Sediment	Total+
Box Elder, Cache Counties:					
Local supply, small dairies	15	29.9	39.1	9.7	88.7
Shipped-in supply, 4 large dairies	3	34.7	40.0	9.6	94.3
Ogden, Salt Lake, Provo area:					
Local supply, small dairies	41	30.3	39.0	9.7	89.0
Local supply, 4 large dairies	10	32.2	39.5	9.7	91.4
Rest of state:					
Local supply, small dairies	41	29.8	38.8	9.7	88.3
Shipped in supply 4 large dairies	21	33.4	39.9	9.6	92.9
Average	131	30.9	39.0	9.7	89.6
Possible score		35.0	45.0	10.0	100.0

* Samples were scored according to the score card recommended by the American Dairy Science Association.

+ Temperature, container and closure were scored the maximum of 10 points for all samples and are included in the total.

milk flavor and milk which is considered to be excellent by today's flavor standards.

Thus, of the 6 point reduction on basis of flavor, 5 are owing to the customary way of scoring rather than a deficiency in flavor of the milk. Under this way of scoring, a bacteria score of 35 and a flavor score of 40 are comparable. Hence, there was in reality only a 5.4 difference between excellent milk with a score of 95 and the average scores of these samples. Of this difference, 4.1 points are caused by higher bacteria count than is warranted in excellent milk, 1.0 point is the result of flavor deficiency, and 0.3 of a point is owing to sediment found in the samples.

VARIABILITY IN QUALITY OF INDIVIDUAL SAMPLES

The variation in scores of fluid milk was much greater among samples taken from the small local dairies than the 4 largest plants which shipped milk to outlying areas. A total of 56 samples were obtained from small, local plants in the Box Elder-Cache County and the Ogden,

Table 15. *Number of fluid milk samples according to source of milk and ADSA scores, fluid milk marketing study, Utah, 1950-52*

Range in scores	Source of milk					
	Small local dairies areas I & II		Small local dairies all areas		Four large dairies area III	
	No. of samples	Percent of total	No. of samples	Percent of total	No. of samples	Percent of total
95 - 100	----	----	1	2	----	----
90 - 94	38	68	29	71	30	88
85 - 89	9	16	3	7	4	12
75 - 84	4	7	4	10	----	----
65 - 74	3	5	----	----	----	----
Below 65	2	4	4	10	----	----
Average	56	100	41	100	34	100

Salt Lake, Provo areas (table 15). Thirty-eight or 68 percent of them scored above 90, and 16 percent between 85 and 89. The remaining 16 percent of samples scored under 85 and 2 of these samples scored below 65.

A similar distribution of scores was found among the 41 samples obtained in area III from the small, local dairies. In this sparsely settled region of the state 71 percent of the samples scored above 90, 17 percent scored between 75 and 85, and 4 samples or 10 percent scored under 65.

The milk obtained from the four largest dairies was more uniform. Of the 34 samples obtained from these dairies 88 percent scored between 90 and 94 and 4 samples or 12 percent scored between 85 and 89. None of these samples scored below 85. The over-all variation among samples was a low of 55.3 and a high of 95.6.

Bacteria counts ranged from 200 to 230,000 with bacteria scores varying between 0 and 35. Milk should have a bacteria count under 30,000; however, it is considered harmful if pathogenic bacteria are present regardless of number. One hundred thirteen samples or 86 percent had bacteria counts under 30,000. Of the remaining 18 samples, 6 had counts between 30,000 and 50,000, 7 between 50,000 and 100,000, and 5 had bacteria counts above 100,000. There were 57 samples or 44 percent with counts under 5,000, and 106 samples or 80 percent with bacteria counts under 20,000.

QUALITY ACCORDING TO TYPE OF MILK

Three types of milk samples were picked up. Creamline milk was obtained primarily from small, local dairies. Homogenized milk was sold by larger dairies in paper cartons, and 6 samples of premium milk were obtained. The primary difference between premium and cream-

line milk was the higher butterfat content of the former. This type of milk had an average fat content of 4.4 percent compared with 3.6 for the 73 samples of homogenized, and 3.7 fat test for the 52 samples of creamline milk.

There was a difference of 2.2 points among the three kinds of milk, with creamline averaging 88.1 points, premium 88.4, and homogenized 90.3. This difference was probably caused less by the type of milk, than by the plant from which the milk was obtained. Local dairies sold most of the creamline milk and the 4 largest dairies most of the homogenized milk.

QUALITY ACCORDING TO PLACE SAMPLE WAS OBTAINED

Quality was also ascertained according to retail outlet. There was little difference between scores of milk obtained from the plant sales front and those obtained from stores. What difference did occur was probably a result of the difference in the processing plants from which the milk originated.

The 6 samples of milk from cafes scored an average of 81.0 points compared with 89.5 for milk from the plant and 90.9 from stores (table 16). The difference was in bacteria scores. Milk from cafes had a bacteria score averaging 22.4 points or 9.7 less than milk from stores. Average bacteria count was 59,000 for the 6 samples obtained from cafes compared with a count of 12,000 from stores.

All milk bought in cafes is not of poorer quality than that sold in stores or from plant sales fronts. Actually some of the milk sold in cafes was of as high quality as that sold in stores. The variation in quality of milk from cafes was so great, however, that the average quality was much lower than samples obtained elsewhere. Among these 6 samples from cafes is 1 which scored only 56.9 points, the result primarily of an extremely high bacteria count. When this

Table 16. *Quality of fluid milk purchased in various places, Utah, 1950-52*

Place sample was obtained	No.	Quality scores*				
		Bacteria	Flavor	Sediment	Temperature, container, and closure	Total
Plant	77	30.8	39.0	9.7	10.0	89.5
Store	48	32.1	39.0	9.8	10.0	90.9
Cafe	6	22.4	39.0	9.6	10.0	81.0
Average	131	30.9	39.0	9.7	10.0	89.6

* Samples were scored according to the score card recommended by the American Dairy Science Association.

score is omitted the average for the 5 samples is 85.8 or 3.7 points less than milk obtained from plants. One other sample obtained from a cafe scored only 72.4 while the next highest was 84.9. Two of them scored higher than 90 and one made a score of 94.4.

LITTLE RELATION BETWEEN DAYS ON COLD SHELF AND QUALITY

Milk was scored according to number of days the samples had been on the cold shelf in the store, cafe, or plant. There appeared to be little relationship between number of days on the cold shelf and the quality. Samples which had been bottled for two days scored higher on the average than any of the other samples. One day old samples scored lowest. The 41 samples with unknown time interval between bottling and sampling represent primarily carton milk. Samples were found which, according to store managers, had been on their cold shelf for as high as six days and scores of these samples indicated no measureable deterioration in quality (table 17).

Table 17. *Quality of fluid milk according to time between bottling and pickup, fluid milk marketing study, Utah, 1950-52*

Time interval between bottling and sample pickup	No.	Quality scores*				
		Bacteria	Flavor	Sediment	Temperature container, and closure	Total
Unknown	41	31.5	39.0	9.8	10.0	90.3
Same day	59	30.7	39.0	9.8	10.0	89.5
One day	25	29.8	39.0	9.5	10.0	88.3
Two days	6	33.3	38.0	9.6	10.0	90.9
Average	131	30.9	39.0	9.7	10.0	89.6

* Samples were scored according to the score card recommended by the American Dairy Science Association.

FLAVOR CRITICISM

Flavor is probably the most important characteristic of milk influencing volume of sales. Off flavor accounted for some of the loss in quality. The most frequently mentioned single flavor criticism was oxidization occurring in 24 or 18 percent of the samples. Cooked flavor occurred in 11 or 8 percent of the samples, and feed flavor in 5 percent of them.

APPENDIX

EXPLANATION OF TERMS

Milk equivalent is a means of converting the cost of processing and distributing each product handled by the plant to a common denominator, thus making it possible to compare cost efficiencies among plants which handle a variety of products and in different relative amounts.

The values assigned each product were largely determined by Montana milk plant operators in a study made in 1947[17]. In this study, plant operators were asked to estimate the relative unit cost of processing and distributing each product they handled. The average estimates for each product were consistent with those used in a study made in New Jersey several years earlier[18].

Milk equivalents for each of two general functions were used. The first, plant processing milk equivalent, is the average relative per unit cost necessary to process each product. One quart of bottled milk was given a value of 1.00. Other products were assigned a value based on the unit cost of processing them compared with one quart of bottled milk.

For example, it was estimated that the cost of processing and bottling a ½ pint container of milk was 70 percent as much as a quart container of fluid milk (value of the fluid milk excluded). Thus half pints of milk were assigned the value of 0.70 milk equivalents.

Second, milk equivalents for allocation and comparison of distribution costs were also determined. Here again one quart of bottled milk was assigned the value of 1.00 and other products were assigned values based on the relative cost of selling and delivering each unit of the product compared with one quart of bottled milk.

Plant processing costs are costs involved in purchasing, processing, and storage of products prior to their being loaded on delivery trucks. This excludes the cost of products and packaging costs.

Delivery costs are those involved in selling and delivering the products from the plant to the purchaser.

Administration costs are expenses pertaining to keeping of plant payroll, route collection, and receipt records and some miscellaneous expenses such as manager's travel expense, subscriptions, and phone costs.

Grade "A" milk is milk produced under strict Department of Public Health and State Department of Agriculture standards and can be used in the manufacture of any dairy product. Only grade A milk can be used in the manufacture of bottled or cartoned milk and cream, chocolate milk, buttermilk, skim milk, and yogurt.

Manufacturing milk is a term describing milk which is presently produced under limited restrictions. It cannot be used in the manufacture of products which must be made of grade A milk, but can be used for butter, cheese, cottage cheese, evaporated milk, condensed milk, ice cream, dry milk, and such other products as are designated by the Board of Agriculture[19].

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[17] Korzan, Gerald E., *Op. cit.*

[18] Spencer, Leland. *Costs of distributing milk in New Jersey.* New Jersey Department of Agriculture, 1943. p. 95-96.

[19] *Dairy Laws,* Laws of Utah, 1945 and amendments, 1951.

Appendix table 1. *List of products handled and the milk equivalents for 33 fluid milk processing plants in Utah, and 9 in Montana,* 1950

Product	Size of package	Milk equivalent		
			Sell and deliver	
		Process	Wholesale	Retail
Milk, creamline	gallon	2.40	2.00	2.10
Milk, creamline	2 quarts	1.65	1.40	1.50
Milk, creamline	quart	1.00	1.00	1.00
Milk, creamline	pint	.85	.85	.90
Milk, creamline	½ pint	.70	.70	.80
Milk, creamline, paper	½ pint	.....	.80	.90
Milk, homogenized	2 quarts	1.65	.....	1.50
Milk, homogenized, paper	quart	.....	.75	.90
Milk, premium	2 quarts	1.65	.....	1.50
Milk, premium	quart	1.00	.....	1.00
Milk and cream, bulk	lb. BF	8.00	7.00	.....
Cream, whip	gallon	4.00	2.40	.....
Cream, whip	quart	2.00	1.00	1.10
Cream, whip	pint	1.65	.85	1.00
Cream, whip	½ pint	1.25	.75	.90
Cream, coffee	gallon	3.50	2.40	.....
Cream, coffee	quart	1.75	1.00	1.10
Cream, coffee	pint	1.40	.85	1.00
Cream, coffee	½ pint	1.00	.75	.90
Cream, coffee, paper	½ pint	.....	.....	.75
Cream, sour	pint	1.50	.....	.85
Cream, raw	gallon	3.25	2.00	.....
Cream, half and half	quart	1.75	1.00	1.10
Cream, half and half	pint	.....	.85	.85
Redi-whip	pint	.....	.....	.85
Redi-whip	½ pint	.....	.75	.....
Milk, skim	gallon	4.00	2.00	2.00
Milk, skim	quart	2.00	1.00	1.10
Buttermilk	gallon	3.80	2.00	2.00
Buttermilk	quart	1.90	1.00	1.10
Buttermilk	pint	1.55	.85	1.00
Buttermilk	½ pint	1.15	.85	.90
Buttermilk, paper	quart	.....	1.00	1.00
Buttermilk, paper	½ pint	1.15	.75	.....
Chocolate drink	gallon	2.50	2.00	.....
Chocolate drink	quart	1.25	1.00	1.10
Chocolate drink	pint	1.00	.85	1.00
Chocolate drink	½ pint	.75	.75	.90
Chocolate drink, paper	quart	.....	.90	1.00
Orange drink	gallon	2.00	2.00	.....
Orange drink	quart	1.00	1.00	1.10
Orange drink	pint	.80	.85	.95
Orange drink	½ pint	.70	.75	.90

Appendix table 1. *List of products handled and the milk equivalents for 33 fluid milk processing plants in Utah, and 9 in Montana, 1950—continued*

Product	Size of package	Milk equivalent		
			Sell and deliver	
		Process	Wholesale	Retail
Cottage cheese	5 lb.	.....	3.50	.....
Cottage cheese	pound	1.50	.75	1.25
Cottage cheese	12 oz.	1.40	.65	1.15
Cottage cheese	½ lb.	1.30	.50	1.00
Cream cheese	12 oz.	1.30	.....	.....
Midget cheese	pound	.....	.....	1.25
American cheese	pound	.....	1.00	1.00
Other cheese	pound	.....	1.00	1.00
Butter	pound	1.00	.50	.90
Butter (chips)	pound	.....	.....	1.10
Ice cream	gallon	5.00	3.00	3.00
Ice cream	quart	3.00	2.00	2.00
Eggs	dozen	.....	1.00	1.00
Yogurt	quart	1.80	1.00	1.10
Yogurt	pint	1.50	.....	.90
Mix, 6 percent	gallon	.....	2.00	.....
Egg nog	quart	.....	.....	1.00
Egg nog	pint	.....	.....	.90
Powdered milk	pound	.....	1.00	.....
Margarine	pound	.....	.....	.90
Other sales	dollar	.....	7.00	7.00

Appendix table 2. *Operating costs per milk equivalent, and cost of butterfat, labor, and capital, 33 fluid milk processing plants in Utah, and 9 in Montana,* 1950

Area in which plant is located	Operating costs per milk equivalent					Cost of A grade BF per pound	Cost labor per hour	Valuation of capital used in processing per milk equivalent	Seconds per milk equivalent processed
	Number milk equivalents processed	Processing	Delivery	Administration	Total				
	000	*cents*	*cents*	*cents*	*cents*	*dollars*	*dollars*	*cents*	*seconds*
				UTAH					
III	75	4.2	1.9	0.6	6.7	.95	.86	4.9	89
III	94	5.7	3.0	0.6	9.3	1.27	1.00	8.0	76
III	109	4.0	1.9	0.4	6.3	1.29	1.00	6.6	65
III	113	4.1	3.1	0.5	7.7	1.23	1.36	5.6	72
III	122	5.1	2.2	0.4	7.7	1.16	1.08	23.0	64
III	129	6.0	1.6	0.6	8.2	.94	.93	9.1	145
III	146	3.3	1.8	0.6	5.7	1.12	.88	7.2	58
III	154	3.9	2.8	0.3	7.0	1.40	1.00	6.4	65
III	156	2.4	1.6	0.3	4.3	1.06	1.09	3.7	44
III	158	2.1	2.0	0.1	4,2	1.08	.77	3.9	43
III	198	4.2	2.8	0.3	7.3	1.21	.79	5.7	115
III	200	3.2	2.2	0.3	5.7	1.03	1.00	3.0	56
III	216	5.5	2.6	1.7	9.8	1.00	1.70	15.6	69
II	220	3.2	1.9	1.0	6.1	1.14	.98	3.7	66
III	221	3.0	2.4	0.2	5.6	1.06	1.04	5.4	54
II	240	2.3	2.2	0.5	5.0	1.18	1.01	2.6	37
I	249	3.8	3.0	0.6	7.4	1.07	1.22	8.2	64
I	277	2.2	0.8	0.1	3.1	1.23	1.11	6.1	20
III	369	2.6	1.2	0.2	4.0	1.31	1.23	4.5	37
III	391	2.4	3.4	0.5	6.3	1.11	1.00	2.3	41
III	416	2.4	4.5	0.2	7.1	1.32	.97	3.4	38
III	447	3.2	2.9	0.5	6.6	1.04	1.02	6.2	46
II	494	2.4	2.6	0.5	5.5	1.19	1.49	*	25

* Part of the capital was rented.

Appendix table 2. *Operating costs per milk equivalent, and cost of butterfat, labor, and capital, 33 fluid milk processing plants in Utah, and 9 in Montana, 1950—continued*

Area in which plant is located	Operating costs per milk equivalent					Cost of A grade BF per pound	Cost of labor per hour	Valuation of capital used in processing per milk equivalent	Seconds per milk equivalent processed
	Number milk equivalents processed	Processing	Delivery	Administration	Total				
	000	*cents*	*cents*	*cents*	*cents*	*dollars*	*dollars*	*cents*	*seconds*
II	574	2.7	2.9	0.5	6.1	1.26	1.22	4.5	31
II	656	2.2	2.2	1.0	5.4	1.21	1.79	2.9	23
III	678	3.0	1.8	0.6	5.4	1.17	.96	1.2	71
I	714	2.1	1.5	0.7	4.3	1.13	1.73	3.4	22
II	920	1.7	2.7	0.3	4.7	1.23	1.43	1.5	19
I	1,031	1.8	1.4	0.7	3.9	1.14	1.52	1.3	32
II	1,055	2.6	2.6	0.7	5.9	1.21	1.44	1.9	33
II	1,254	2.1	2.4	0.3	4.8	1.16	1.26	2.2	32
II	1,653	2.3	3.0	0.7	6.0	1.24	1.46	2.5	31
II	4,305	1.6	2.4	0.5	4.5	1.16	1.62	2.7	21
				MONTANA					
.....	128	4.3	3.0	1.0	8.3	1.35	1.06	15.2	59
.....	324	2.1	1.3	0.2	3.6	1.21	.81	4.9	43
.....	600	2.9	1.8	0.6	5.3	1.25	1.22	6.2	51
.....	699	2.4	1.8	0.4	4.6	1.26	1.32	4.5	35
.....	958	3.1	3.6	0.7	7.4	1.24	.....	2.8	....
.....	1,585	2.9	1.7	0.5	5.1	1.48	1.22	1.2	31
.....	2,178	2.9	2.5	0.8	6.2	1.46	1.09	3.1	29
.....	2,584	2.6	1.6	0.9	5.1	1.31	1.39	1.9	24
.....	3,487	1.3	0.8	0.4	2.5	1.25	1.52	2.3	10